THE EXPLOSIVES ENGINEER

Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

The announcement of the six winners and the accident records of 529 mines and quarries enrolled in the National Safety Competition of 1955 are presented in an article by Seth T. Reese, chief of the Accident Analysis Branch, Bureau of Mines, U. S. Department of the Interior, that begins on page 103. A summary of the records shows the contestants established six new records:

- The 529 mineral operations enrolled experienced an injury-severity rate of 3.872 day lost per thousand man-hours of work – the lowest recorded in the 31-year history of the contest.
- The injury-frequency rate of 19.424 per million man-hours of employe exposure was the lowest recorded since the competition was begun in 1925.
- The number of disabling injuries, fatal and nonfatal, was a record low.
- The metal-mine group established a new low injury-severity rate.
- The bituminous-coal mine group made the lowest injury-frequency rate on record.
- The quarry group recorded a new low injury-frequency rate.

The mines and quarries that participated in the 1955 competition were operated for a total of more than 131 million man-hours. Perfect safety records were achieved by 211 plants, representing 40 per cent of the enrollment. The total worktime of these 211 injury-free plants was more than 19 million man-hours.

Each of the six winning operations – five mines and one quarry – is awarded a bronze Sentinels of Safety trophy donated by THE EXPLOSIVES ENGINEER, to be retained for one year. Each winning operation also receives a green-and-white Sentinels of Safety flag from THE EXPLOSIVES ENGINEER. Please turn to page 103.

* * *

One of the most unique highway-construction projects in Texas is the 10.6-mile section of limited-access, express-type, four-lane structure on historic U. S. Route 80 just east of Dallas. The contract for surfacing and finishing the section, totaling $1,814,140, was awarded to Ernest Loyd of Fort Worth. Because of the amount and the variety of equipment required to complete the job, Mr. Loyd sublet part of the contract to three other contractors.

The project called for approximately 637,000 tons of crushed and sized limestone for the base and the surfacing. The required stone for the new highway was obtained from a below-surface quarry 30 to 37 miles from the job site. Because of divided ownership of the quarry property, a slight variation in the limestone formation, and the different locations of the four contractors' rock-crushing units, the operating layout in the quarry was separated into a large and a small pit. The contractors had to strip 23 feet of overburden from the top of the quarry face to uncover a stratum of limestone 25 ft. thick. The stripping resulted in the removal of 423,000 cu. yd. of earth and conglomerate.

The drilling and blasting details in the big pit were on a bench averaging 23 ft. high. A typical primary blast comprised four rows of holes, 25 holes to a row, drilled on a staggered spacing pattern. The height of the bench in the small pit was 18 ft. An average primary blast in the small pit included 70 holes in four rows. Fragmentation from the blasts was excellent, with very little secondary blasting required.

In delivering the crushed stone to the job site, the haulage soared to 20,078,915 ton-miles, topping by far any previous job of this kind in Texas. A fleet of 150 trucks was kept busy making hundreds of trips between the quarry and the construction project.

A description of the details involved in drilling, blasting, crushing, and delivering the limestone requirements to this unusual construction project starts on page 119.

EDITORIAL STAFF: JOSEPH I. HORTY, *Editor*; GERTRUDE A. DONNELLY, *Assistant Editor*; ELIZABETH M. JOYCE, *Associate Editor*; EDWARD L. GRANT, *Art Editor*; FRANK J. CANOVA, *Production Manager*; CHARLES E. RABENOLD, *Advertising Manager*; MONTGOMERY R. BUDD, *Director*.

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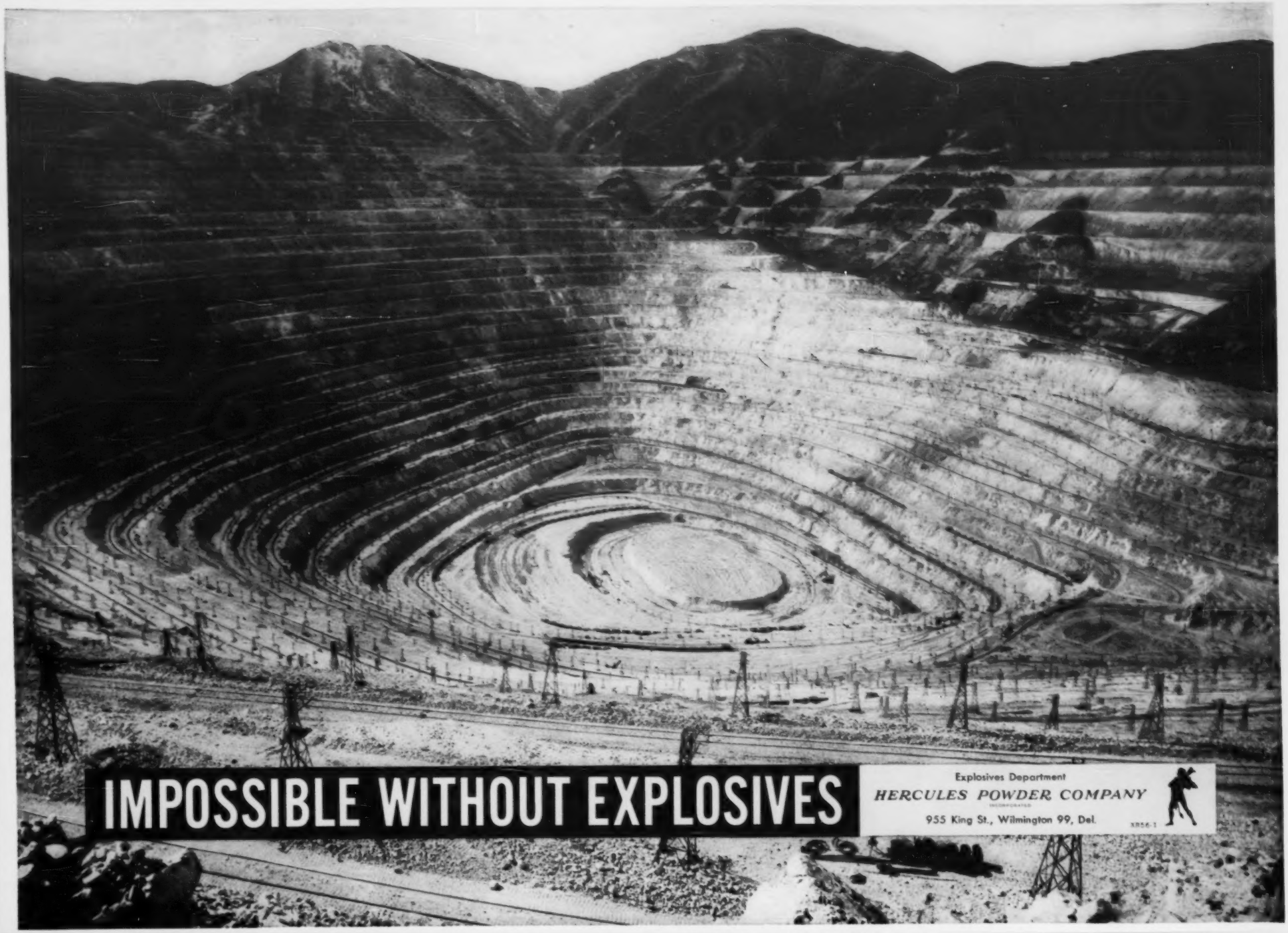
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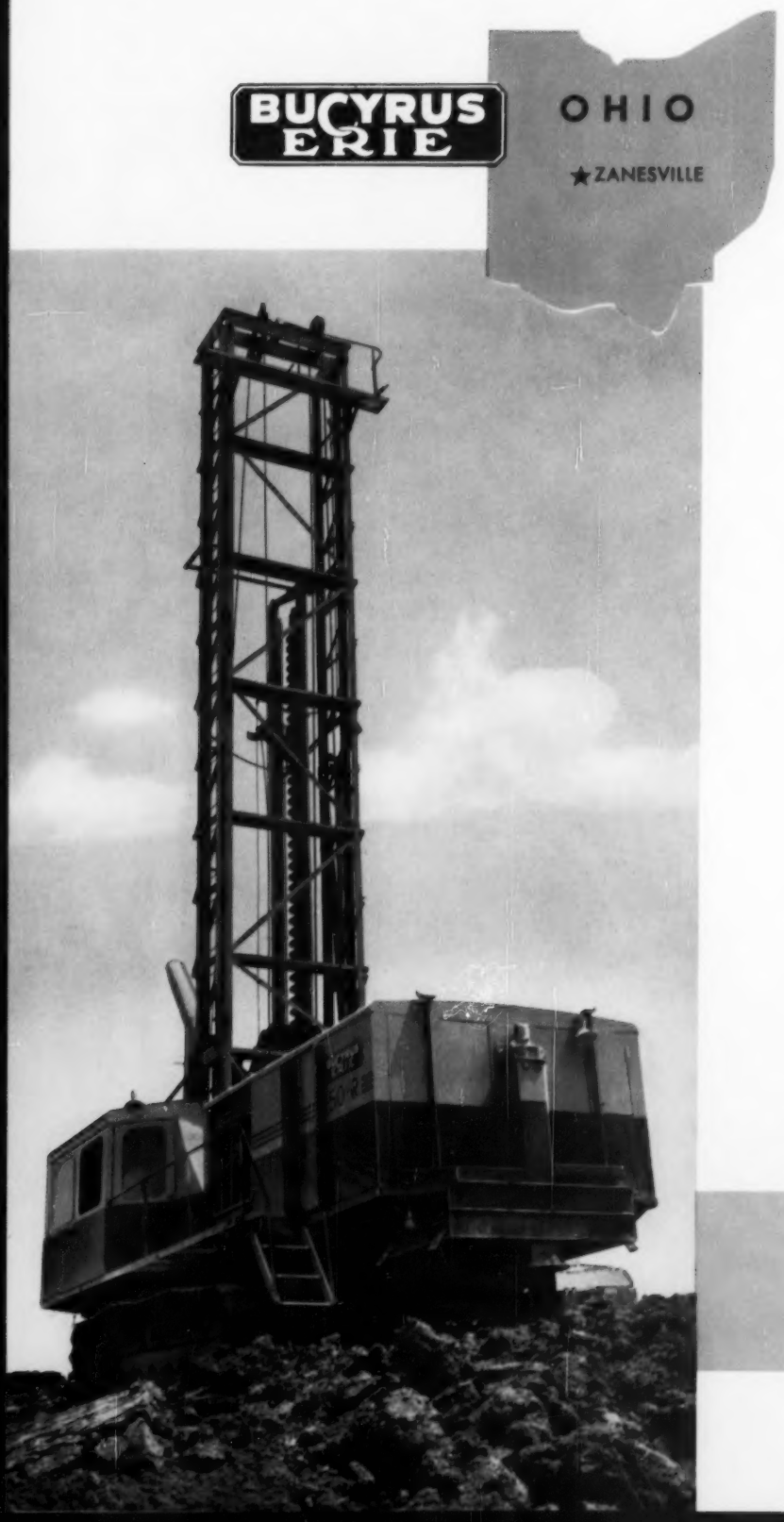
ZANESVILLE, OHIO . . . another example of how Bucyrus-Erie rotaries cut costs on big-volume stripping jobs



At the Central Ohio Coal Company mine, this 50-R drilling 10⅝-in. holes through mixed overburden put down an average of 95 feet per shift hour during a period covering 20 shifts. Figuring actual drilling time at 80%, this was an average penetration of 118½ feet per drilling hour. The overburden consisted of approximately 35% clay, 25% sandstone, 35% shale, and 5% limestone with occasional fireclay over the coal seam.

Such outstanding performance has been demonstrated in many types of formations all over the country by the 50-R, which drills 9⅞- to 12¼-in. holes. Here are just a few of the many reasons for its success:

1. Hydraulically-powered down pressure on the bit provides maximum controlled penetration.
2. Ward Leonard electric control on rotation of the drill stem permits drilling at the most efficient speed for a given formation.
3. Hole can be drilled continuously for 32 ft. 9 in. before an additional drill pipe section has to be added.
4. Compressed air is used to remove cuttings and to cool the bit. Fine cuttings are picked up and handled by a Roto-Clone precipitator; heavies pile up adjacent to the drill hole for use as stemming material.
5. A remote-controlled, power-driven drill pipe rack eliminates any manual effort on the operator's part when adding or removing drill pipe.

Let us tell you more about the speed and economy of Bucyrus-Erie rotary blast hole drills, including the 40-R, which drills 6¾- to 9-in. holes. Write today for detailed, illustrated literature. 43856C

BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

THOMAS JOSEPH WALSH, JR.

Thomas Joseph Walsh, Jr.

PRESIDENT, WALSH CONSTRUCTION COMPANY

PRESIDENT, THE MOLES

A Biography

In 1953, at the age of forty, Thomas Joseph Walsh, Jr., was elected president of Walsh Construction Company. He was the third-generation member of the Walsh family to become the chief administrative officer of one of the outstanding contract-organizations in the industry. His recent election to the presidency of The Moles, an association of heavy-construction engineers and executives, was a tribute to his recognized abilities and his warm appreciation and understanding of his fellow men.

Tom, as his friends and associates know him, was born in Davenport, Iowa, on October 23, 1913, the son of Thomas J. and Gabrielle M. (Bilderback) Walsh. His father, now chairman of the board of directors of Walsh Construction Company, was its president from 1916 to 1946, having succeeded his father, Patrick T. Walsh, who founded the company in 1899.

Following completion of his elementary education at St. Mary's School, Kansas, in 1931, Tom matriculated at the University of Notre Dame in South Bend, Indiana. He was graduated from Notre Dame in June, 1935, with a Bachelor of Arts degree.

When Tom was fourteen, he went to work for the first time, during summer vacation months, as a water boy on one of the Walsh company's construction jobs.

After his graduation from Notre Dame, he became a full-time member of the Walsh company's organization and was immediately assigned to its Grand Coulee dam project. After two years at Grand Coulee, Tom was transferred to New York City to work on the Queens-Midtown tunnel. From 1939 to 1941, he helped in the driving of tunnels and the sinking of shafts for New York City's Board of Water Supply.

His next assignment took him to the Island of Trinidad in the British West Indies, where he supervised the construction of air bases and facilities for the United States Army forces during 1941 and up to mid-1942. At that time, he was given a leave of absence from the company to join the U. S. Navy's Sea Bees.

Following service with the Sea Bees in the Pacific area during World War II, Tom was given his discharge from the Navy in 1945. He rejoined Walsh Construction Company at its New York headquarters and eight years later was elected to the presidency of the company, the position he holds today.

The early, and still-continuing, interest of Walsh Construction Company in work for railroads made it world famous in that field. Its interest, however, is by no means limited to railroad construction. It has driven more tunnels than any similar organization in the world. In association with other contracting firms, it had a hand in the building of Fort Peck dam, the Delaware Aqueduct, and myriad miles of tunnels for various Water Districts throughout the United States, Canada, and Australia. It built bases in France for the U. S. Army Air Corps and is currently constructing similar bases in Spain. It was one of four companies that built the United Nation's secretariat building in New York City. With general offices located in New York, it maintains district offices in San Francisco, California, and Toronto, Ontario, Canada.

Tom is an active member of the Wee Burn Country Club, the New York Athletic Club, and the Touchdown Club.

Thomas Joseph Walsh, Jr., married Ann Liddle on January 15, 1940, in Chicago, Illinois. They have four children – three sons and a daughter. The family home is on Old Rock Lane in Norwalk, Connecticut.

With a crowded schedule of business activities, Tom Walsh has little time left to indulge his hobbies. But, when time and opportunity permit, he can be found on a nearby golf course, or on hunting and fishing expeditions with his friends.

THE WINNERS 1955

Anthracite

GERMANTOWN COLLIERY

RAVEN RUN COAL COMPANY

Centralia, Pennsylvania

Bituminous-Coal

LABUCO MINE

ALABAMA BY-PRODUCTS CORPORATION

Flat Creek, Alabama

Metal

ZENITH MINE

PICKANDS MATHER & CO.

Ely, Minnesota

Nonmetallic

BELL MINE

WARNER COMPANY

Bellefonte, Pennsylvania

Open-Pit

ERIE COMMERCIAL MINE

PICKANDS MATHER & CO.

Aurora, Minnesota

Quarry

HILLSVILLE LIMESTONE QUARRY

UNITED STATES STEEL CORPORATION

Hillsville, Pennsylvania

"Let the worker carry around with him a mental picture of his wife and child, whose happiness depends upon his safe return after the day's work, and these loved ones become his surest sentinels of safety."

– January 1925, The Explosives Engineer

THE National Safety Competition OF 1955

A review of the records of 529 mines and quarries located in 43 states shows 211 with no lost-time injuries during a total worktime of more than 19 million man-hours

SETH T. REESE*

THE 529 mineral operations in the United States that participated in the National Safety Competition of 1955 attained the best overall record since this annual contest started in 1925, or 31 years ago.

The experience, as measured by an injury-severity rate of 3.872 days lost per thousand man-hours, was lower than in any other year and significantly better than the next succeeding one of 4.051 in the 1953 competition. The frequency of occurrence of disabling injuries – 19.424 per million man-hours – was also lower than in any other of the 31 contest years. This new low record rate was gratifyingly better than the previous record rate of 22.036 injuries per million man-hours in the 1954 contest.

In addition to establishing the overall record low frequency and severity rates in the 1955 contest, a record low injury-frequency rate was recorded for the bituminous-coal group; the injury-severity rate in the metal-mining group was the lowest recorded; the frequency rate for the quarry group was a new low; and the total number of disabling injuries, including those resulting in ultimate or instant death, was less than in any year of the 31 years of competition.

New Records Year after Year

Records made in 1955 clearly attest to the effectiveness of this contest in promoting accident prevention at plants where safety is aggressively and efficiently included in each day's cycle of operations. Since this contest was begun in 1925 by the Bureau of Mines, United States Department of the Interior, in cooperation with THE EXPLOSIVES ENGINEER, outstanding performances in safety have been recorded year after year.

This annual competition, one of several conducted by the Bureau of Mines, has an extremely useful purpose: to alert and hold the interest of employes and officials in accident-prevention work. Statistics reveal that the average mine or quarry that has participated in the contest attains a better safety record than the average mineral operation that is not in the competition.

In 1955, the participating mines and quarries operated a total of more than 131 million man-hours, during which time of exposure to work hazards there were 2,547 disabling injuries. Of this number, 53 were fatal and 2,494 were nonfatal injuries. The total time lost from all injuries was 507,709 days, with 318,000 days chargeable to fatal injuries and 189,709 days to nonfatal.

Of the six group classifications of plants, as designated in the rules of the contest, the open-pit classification had the lowest injury-severity rate and the quarry group the lowest injury-frequency rate. The highest rates were in the anthracite group.

National recognition is due and is accorded to the mineral operations that won top safety honors in the six group classifications. For achieving the best record in each group, each of the six winners is awarded a bronze Sentinels of Safety trophy and a green-and-white Sentinels of Safety flag, donated by THE EXPLOSIVES ENGINEER. In addition, every employe at the six winning plants will receive a Certificate of Achievement in Safety from the

*Chief, Branch of Accident Analysis
Division of Safety, Bureau of Mines
U. S. Department of the Interior

GERMANTOWN MINE EMPLOYES: A group of mine employes at the Germantown Colliery of Raven Run Coal Company, Centralia, Pennsylvania, are photographed at the top of the Merriam shaft. This mine won the Sentinels of Safety trophy and flag in the anthracite group during a worktime of 360,900 man-hours in 1955.

GERMANTOWN'S SUPERVISORS: The supervisory force at Germantown Colliery includes, front row, left to right, Albert MacElrath, Albert Oshinski, Francis Bergen, John Bugel, and James Kealy. In the back row, left to right, are Michael Waskovich, division superintendent; G. Chester Davis; Earl Yeager, mine foreman; Waldo Bucher; Richard Green, outside foreman; Anthony Gaughan; Benjamin Heckman, master mechanic; and Frank O'Connor.

SAFETY COMMITTEE: Germantown's safety committee members are, left to right, John Eidleman, safety engineer; James Flannery; Michael Cheddar; and Joseph Donahue.

Bureau of Mines in recognition of his own contribution to his plant's record.

Following the announcement of the six winners, the usual practice has been to have official presentations of the Sentinels of Safety trophies, flags, and individual certificates made at a time and place to be determined by each winning company, through arrangements made with the Bureau of Mines.

The Winners

The winners in the National Safety Competition of 1955, confirmed unanimously by the Committee of Award, are:

Anthracite mines, underground: Germantown Colliery, Raven Run Coal Company, Centralia, Columbia-Schuylkill-Northumberland Counties, Pennsylvania.

Bituminous - coal mines, underground: Labuco Mine, Alabama By-Products Corporation, Flat Creek, Jefferson County, Alabama.

Metal mines, underground: Zenith Mine, Pickands Mather & Co. (Vermillion Mining Company), Ely, St. Louis County, Minnesota.

Nonmetallic mines, underground: Bell Mine, Warner Company (Bellefonte Division), Bellefonte, Centre County, Pennsylvania.

Open-pit mines: Erie Commercial Mine, Pickands Mather & Co. (Erie Mining Company), Aurora, St. Louis County, Minnesota.

Quarries: Hillsville Limestone Quarry, United States Steel Corporation (Michigan Limestone Division), Hillsville, Lawrence County, Pennsylvania.

Anthracite Mines

Germantown Colliery of Raven Run Coal Company at Centralia, Columbia-Schuylkill-Northumberland Counties, Pennsylvania, achieved top safety honors in the anthracite underground mines group. In 1955, the employes worked 360,900 man-hours with 31 disabling injuries, which caused an aggregate time loss of 390 days. This represents a disabling injury-severity rate of 1.081 days lost per 1,000 man-hours, the best record in the anthracite group.

The awards of the Sentinels of Safety trophy and flag to this mine in the 1955 contest marked the first time Germantown Colliery has won these top honors in its 12 years of participation in the National Safety Competition. Since its enrollment in 1944, there have been instances where the frequency and severity rates, either or both, for a given year were higher than the year immediately preceding. However, a review of the overall injury experience at Germantown Colliery since 1944 shows a gratifying improvement, particularly with regard to the severity rate of disabling injuries – the 1955 rate was the lowest recorded since it was entered in the contest.

The injury-frequency experience at the anthracite mines last year was not as favorable as in 1954. As a group, the 16 mines participating in 1955 had a frequency rate of 79.847 injuries per million man-hours. This was slightly higher than the 1954 rate of 76.126.

MERRIAM SHAFT: This view includes the Merriam shaft and surface structures at Raven Run Coal Company's Germantown Colliery.

ENGINEERING CORPS: Members of Germantown's engineering corps are Frank J. Horn, division engineer, at right; Carl Lasser, in center; and Richard Lasser.

ROCK CREWS: The rock crews at Germantown Colliery operate under the direction of John J. Cullen, extreme right.

LABUCO MINERS: With a perfect safety record during 168,153 man-hours of work underground in 1955, these Labuco Mine employes of Alabama By-Products Corporation at Flat Creek, Alabama, won the Sentinels of Safety trophy and flag for the second successive year.

However, a noticeable improvement was made in the accident-severity rate when compared with the record of the preceding year.

Bituminous-Coal Mines

For the second successive year, Labuco Mine of Alabama By-Products Corporation at Flat Creek, Jefferson County, Alabama, was awarded the Sentinels of Safety trophy and flag for attaining the best safety record among the bituminous-coal mines enrolled in 1955. This mine operated throughout the year without a disabling injury, during a worktime of 168,153 man-hours.

This winning record marked the second straight year of disabling injury-free operations at this property — a total of 278,108 man-hours without a disabling injury. In its 18-year history in the contests, the employes of Labuco Mine have worked more than 4½ million man-hours, recording a frequency rate of 38.887 and a severity rate of 6.485, each being well below the 31-year average rates experienced by the bituminous-coal mine group.

The enrollment in the bituminous-coal mine group in 1955 totaled 77. The severity rate of 5.151 days lost per 1,000 hours was substantially lower than in 1954, and was the second lowest in the 31-year history of these annual contests. The injury-frequency rate of 16.243 per million man-hours was a new low-record rate for mines enrolled in this group since the competition was inaugurated in 1925.

LABUCO'S SUPERVISORS: Seated, left to right: Newton Tuggle, chief electrician; P. H. Word, safety director; G. D. Sparks, mine superintendent; F. L. Glaze, mine foreman; J. E. Maxwell, section foreman. Standing, left to right: G. L. Snyder, section foreman; Hollis Cunningham, section foreman; Clyde Atkinson, section foreman; Sam Kemeys, night mine foreman; W. L. Roy, Jr., cashier.

Metal Mines

Zenith Mine of Pickands Mather & Co. at Ely, St. Louis County, Minnesota, won first place and the awards of the Sentinels of Safety trophy and flag in the metal mines group. The winning record was a perfect one — no disabling injuries in a worktime of 529,373 man-hours through 1955. In achieving top honors among the 53 mines enrolled in this group, Zenith Mine won the coveted bronze trophy for the third time. Its previous awards were in the 1935 and 1954 competitions. In 1933, this mine received honorable mention because of an outstanding safety record.

Zenith Mine has been a participant in the National Safety Competition for 24 years. During this period it was worked almost 12 million man-hours with a frequency rate of 12.729 disabling injuries per million man-hours and a severity rate of 4.203 days lost per thousand man-hours, each rate being well below the respective aver-

age rate for all mines competing in this group for the 31-year period of the contest.

The 53 metal underground mines enrolled in 1955 recorded the best injury-severity rate of any year since the competition was started in 1925. The 1955 rate of 2.259 days lost per 1,000 man-hours was considerably below the previous low rate of 5.681 recorded in the 1954 contest. Furthermore, the frequency of 28.196 injuries per million man-hours represented a marked improvement over the corresponding rate of 34.349 for 1954.

Nonmetallic Mines

The top award for the best safety record in the nonmetallic underground mines group went to the Bell Limestone Mine of Warner Company, Bellefonte Division, at Bellefonte, Centre County, Pennsylvania. In 1955, this mine was worked 264,075 man-hours without a disabling injury. It was the first time since entering the contest 31 years ago that it won top honors in the nonmetallic underground mine group.

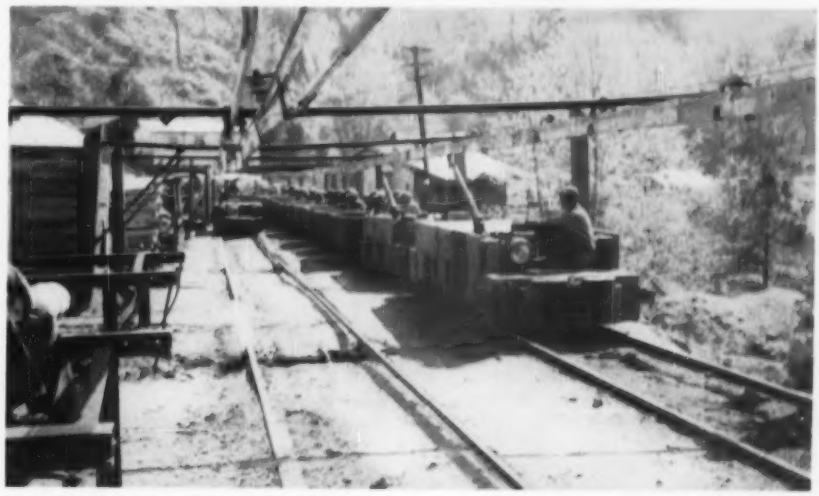
A review of this mine's safety records since 1925 shows that it has been worked 7,032,509 man-hours with a frequency rate of 34.127 injuries per million man-hours and a severity rate of 5.374 per thousand man-hours. During that period, by virtue of outstanding safety records, it received honorable mention in 1931, 1932, 1937, 1951, and 1954. Such accomplishments are realized only by the constant, wholehearted cooperation of all employes in a concerted drive to work safely at all times.

The 54 nonmetallic underground mines participating in 1955 were operated more than 9 million man-hours. They reported a total of 189 disabling injuries. The frequency rate for the group was 20.853 and the severity rate 2.612, each substantially lower than the respective average rate for the contest.

Open-Pit Mines

In the open-pit group, the winner of the Sentinels of Safety trophy and flag was the Erie Commercial Mine of Pickands Mather & Co. (Erie Mining Company) at Aurora, St. Louis County, Minnesota. The mine had no disabling injuries in 1955, during an operating time involving 558,010 man-hours of

SAFETY COMMITTEE: The safety committee at Labuco Mine comprises, left to right, James Johnson, Lucius Salters, and John Kitchens.



MAN TRIP: Employes in Labuco Mine are transported in cars from underground workings to the surface trolley yard by electric locomotives.

PREPARATION PLANT: The coal mined at Labuco is prepared for shipment to the market in this plant of Alabama By-Products Corporation at Praco, Alabama.

WARNER COMPANY'S BELL MINERS: The top award for the best safety record in the nonmetallic underground mines group in 1955 went to the Bell Limestone Mine of Warner Company's Bellefonte Division at Bellefonte, Pennsylvania. Its record of 264,075 man-hours of work with no lost-time injuries was the best among the 54 mines competing in this classification.

SURFACE STRUCTURES: This picture provides an excellent view of the plant and surface structures at the Bell Mine location in Bellefonte, Pennsylvania.

SUPERVISORY STAFF: Seated, left to right, Carl Zong, production foreman; H. A. Corre, mine superintendent; W. H. Smith, mining and maintenance foreman. Standing, left to right, Harold Gentzel, stope miner; Robert Dinges, surface foreman; Harry McMullen, mine clerk; Melvin Dunlap, stope foreman; Raymond Long, development foreman; Clark Charles, night production foreman.

work. The victory was particularly noteworthy since it was the first year the Erie Commercial Mine has participated in this nation-wide safety contest.

The injury experience at the 94 participating open-pit mines in 1955 was not as favorable as in the preceding year. The disabling injury-severity rate of 2.190 days lost per 1,000 man-hours of exposure was slightly higher than the 1954 rate of 1.882. The frequency rate of 11.488 was also appreciably higher than the rate established in the previous contest year.

Quarries

The Hillsville Limestone Quarry of United States Steel Corporation, Michigan Limestone Division, at Hillsville, Lawrence County, Pennsylvania, won the Sentinels of Safety trophy and flag in the quarry group for its record of operating 400,053 man-hours without a disabling injury.

The Hillsville quarry was enrolled in the competition for the first time in 1951. Its winning top honors in 1955 marks its second victory since entering the contest – it won first place in 1952.

During the five-year period of Hillsville quarry's participation in the competition, only eight disabling injuries have occurred during 2,353,221 man-hours of work for an injury-severity rate of 0.236 days lost per thousand man-hours and a frequency rate of 3.400 per million man-hours. This is truly an outstanding safety record.

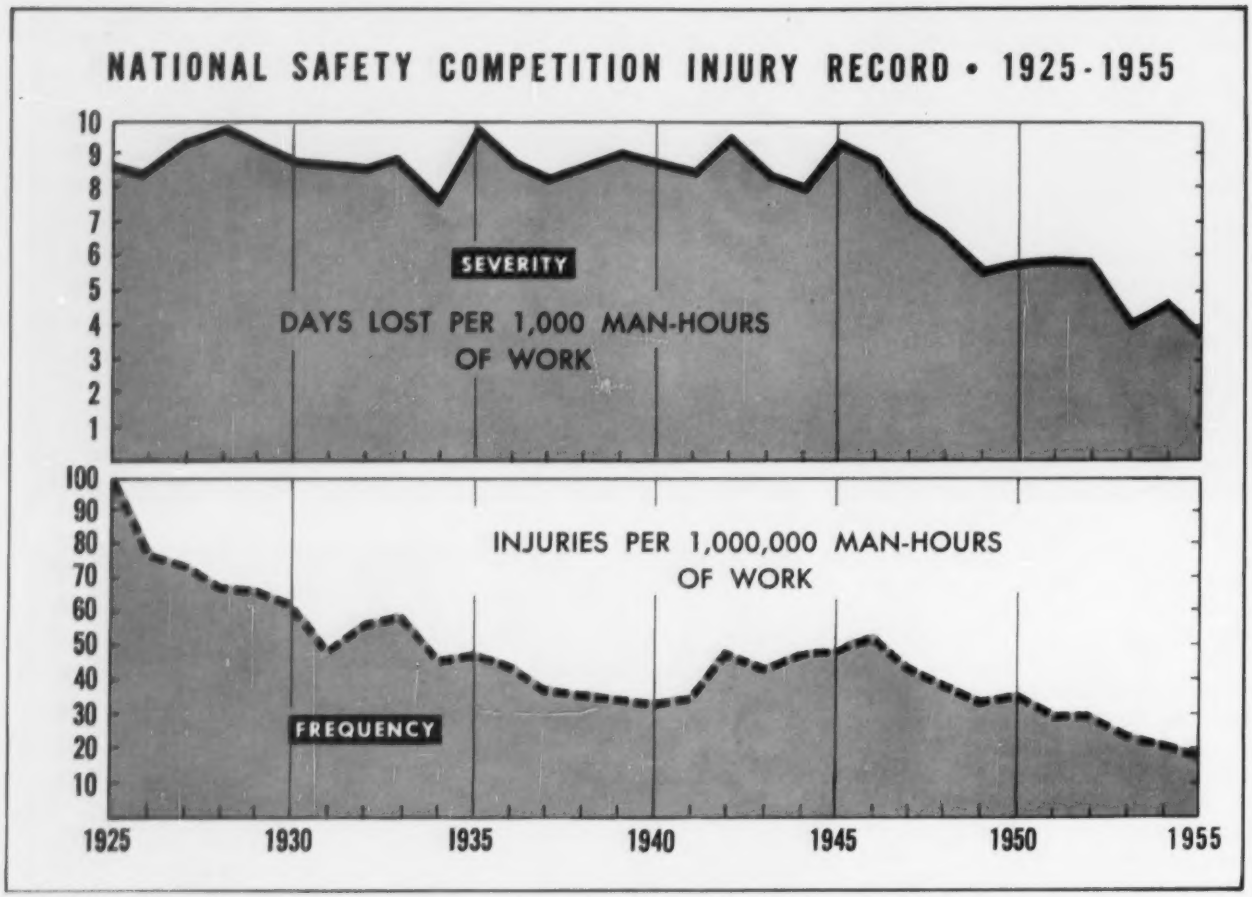
As a group, the 235 quarries enrolled, which equals the record high enrollment in 1954, had favorable safety records in 1955. The injury-severity rate of 2.952 days lost per thousand man-hours was the sixth best annual rate in the 31 years of the contest. The frequency rate of 9.577 disabling injuries per million man-hours was the best annual rate attained by the quarry group in the entire history of the competition.

Perfect Safety Records

In the 1955 contest, 211 of the enrolled plants (40 per cent) achieved perfect safety records, thus establishing definite proof of the close cooper-

MAIN DRIFT: This is a section of the main drift in the Bell Limestone Mine of Warner Company at Bellefonte, Pennsylvania.

SAFETY COMMITTEES: Members of the mine and plant safety committees are, front row, left to right, John Smith, Morris Houser, Robert McDowell, Jr., Carl Deter, James Sents, Andrew Knapik, Fred Lose, Paul Rachau, and Guy Johnson, chairman. Back row, left to right, John Jurkovich, James Evock, James Masulb, Leonard Tierney, William St. Clair, Harry Haagen, and Clark Charles.



SALIENT FEATURES OF THE NATIONAL SAFETY COMPETITION
1955

Type of Mine	*Number of Mines*	*Man-hours*	*Fatal Injuries*	*Nonfatal Injuries*	*Total*	*Days of Disability*	*Frequency Rate*	*Severity Rate*
Anthracite	16	5,923,807	7	466	473	64,692	79.847	10.921
Bituminous-coal	77	49,251,900	29	771	800	253,690	16.243	5.151
Metal	53	21,598,755	2	607	609	48,790	28.196	2.259
Nonmetallic mineral	54	9,063,563	2	187	189	23,677	20.853	2.612
Total	200	85,838,025	40	2,031	2,071	390,849	24.127	4.553
Open-pit	94	22,109,697	6	248	254	48,431	11.488	2.190
Quarries	235	23,179,681	7	215	222	68,429	9.577	2.952
Grand Total	529	131,127,403	53	2,494	2,547	507,709	19.424	3.872

THE 31-YEAR HISTORY OF THE NATIONAL SAFETY COMPETITION
1925-1955

Type of Mine	*Man-hours*	*Fatal Injuries*	*Nonfatal Injuries*	*Total*	*Days of Disability*	*Frequency Rate*	*Severity Rate*
Anthracite	658,069,859	776	57,392	58,168	6,868,216	88.392	10.437
Bituminous-coal	1,459,538,030	1,428	60,896	62,324	13,536,996	42.701	9.275
Metal	559,942,472	428	19,405	19,833	3,783,176	35.420	6.756
Nonmetallic mineral	145,179,564	87	3,994	4,081	774,220	28.110	5.333
Total	2,822,729,925	2,719	141,687	144,406	24,962,608	51.158	8.843
Open-pit	351,682,336	100	5,548	5,648	971,775	16.060	2.763
Quarries	525,841,328	248	9,759	10,007	2,250,434	19.030	4.280
Grand Total	3,700,253,589	3,067	156,994	160,061	28,184,817	43.257	7.617

ation of all employes in well-organized safety programs. The aggregate worktime of the 211 injury-free plants was more than 19 million man-hours – an outstanding example of the results that can be accomplished by continuing efforts toward eliminating lost-time injuries.

Participating plants that had injury-free records included 140 quarries, 40 open-pit mines, 21 nonmetallic underground mines, 7 metal underground mines, 2 bituminous-coal mines, and 1 anthracite mine. All the employes working at these mines and quarries deserve the highest commendations for such outstanding accomplishments in safety.

Also worthy of note and commendation are 37 plants that remained in the contest with the realization that they could not receive trophies, flags, or certificates because their operating time was less than 30,000 man-hours, the minimum worktime requirement for eligibility. Many of these operations have enrolled in the contest year after year. The Bureau of Mines extends to each its heartiest congratulations for their determined interest in accident-prevention work despite their known inability to meet the minimum requirements for awards.

Basis for Awards

Enrollment in the National Safety Competition is voluntary. Participating plants are grouped into six classifications: anthracite, bituminous-coal, metal, and nonmetallic – all underground mines; open-pit mines; and quarries. Any operation in the United States that qualifies in the above group classifications may enroll in this competition. But, to maintain eligibility for the awards of the Sentinels of Safety trophies, flags, and certificates the participants must be active at least 100 days, and operate not less than 30,000 man-hours during the contest year.

Before a plant is accepted as a contender, a designated official at each mine or quarry must agree to submit a report of every disabling injury and certain employment data to the Bureau of Mines at stipulated intervals. Each injury that results in temporary disability is charged with the number

HILLSVILLE MANAGEMENT TEAM: Front row, left to right, Theodore Bono, plant foreman; James V. Pisciuneri, labor foreman; James Loccisano, assistant quarry foreman; Robert L. Landis, quarry engineer; W. R. Beers, chief accountant. Back row, left to right, John McCord, chief electrician; William P. Druschel, plant manager; Walter L. Stoner, master mechanic; Carl Onasch, shop foreman; William K. Gwin, shop foreman; Joseph Caruso, tipple foreman; Samuel Retort, stripping foreman; Raymond Toler, assistant quarry foreman.

PLANT BUILDINGS: The plant buildings at Hillsville Quarry include the screen house and tipple in center foreground, the secondary crusher and open-hearth loading bins at rear, left, and the top of the primary crusher in the background at right.

SAFETY INSPECTION TEAM: Left to right, J. Walter Baird, assistant manager, stone production, eastern district; J. N. Suliot, manager, eastern district; C. A. Pratt, manager, Moler plant; W. P. Druschel, manager, Hillsville plant; Carl Benton, supervisor of operations, Kaylor plant; Blenn Cook, assistant to director, industrial relations; Bob Ross, assistant plant manager, Annandale; Henry Foringer, safety director, eastern district.

DRILLING BLAST HOLES: Preparations for firing a primary blast in the limestone quarry face at Hillsville start with the drilling of vertical blast holes on a staggered pattern.

of days the injured is away from work, including Sundays, holidays, and all other days, whether the operation was active or idle.

Each death or permanent total injury is charged with 6,000 days. For permanent partial injuries, proper charges are made. These charges are listed in a detailed set of rules which is given each mine and quarry enrolled in the competition. At the close of the contest each year, the calculated severity rate and a summary of the basic figures from which the rate is determined are sent each participant for certification as to accuracy and completeness of the original data furnished by the participant to the Bureau. After the basic figures have been verified by all the enrolled companies, a summary of the records covering man-hours and injuries at each of the five leading contenders in each of the six group classifications is submitted to a committee of seven men, each of whom is nationally known for his interest in promoting safety. No committee member has any connection with the Bureau of

VIEW FROM AN AIRPLANE: These are the Hillsville Limestone Quarry and plant structures at Hillsville, Pennsylvania, as seen from an airplane.

ZENITH MINERS: The Zenith miners of Pickands Mather & Co. at Ely, Minnesota, worked 529,373 man-hours in 1955 with no disabling injuries. That record won first honors in the metal mines group. The victory was doubly impressive because it marked the second straight win for this mine in national competition.

Mines. A majority vote of the members of this committee determines the six winners of the Sentinels of Safety trophies. The voting of this committee for the 1955 winners was unanimous.

The Committee of Award

The members of the Committee of Award for the 1955 competition were:

C. E. Reistle, Jr., president, American Institute of Mining and Metallurgical Engineers;

A. T. Goldbeck, engineering director, National Crushed Stone Association, Inc.;

Charles Ferguson, director, Safety Division, United Mine Workers of America;

Ned Dearborn, president, National Safety Council;

L. C. Campbell, president, National Coal Association;

Howard I. Young, president, American Mining Congress;

G. Donald Kennedy, president, Portland Cement Association.

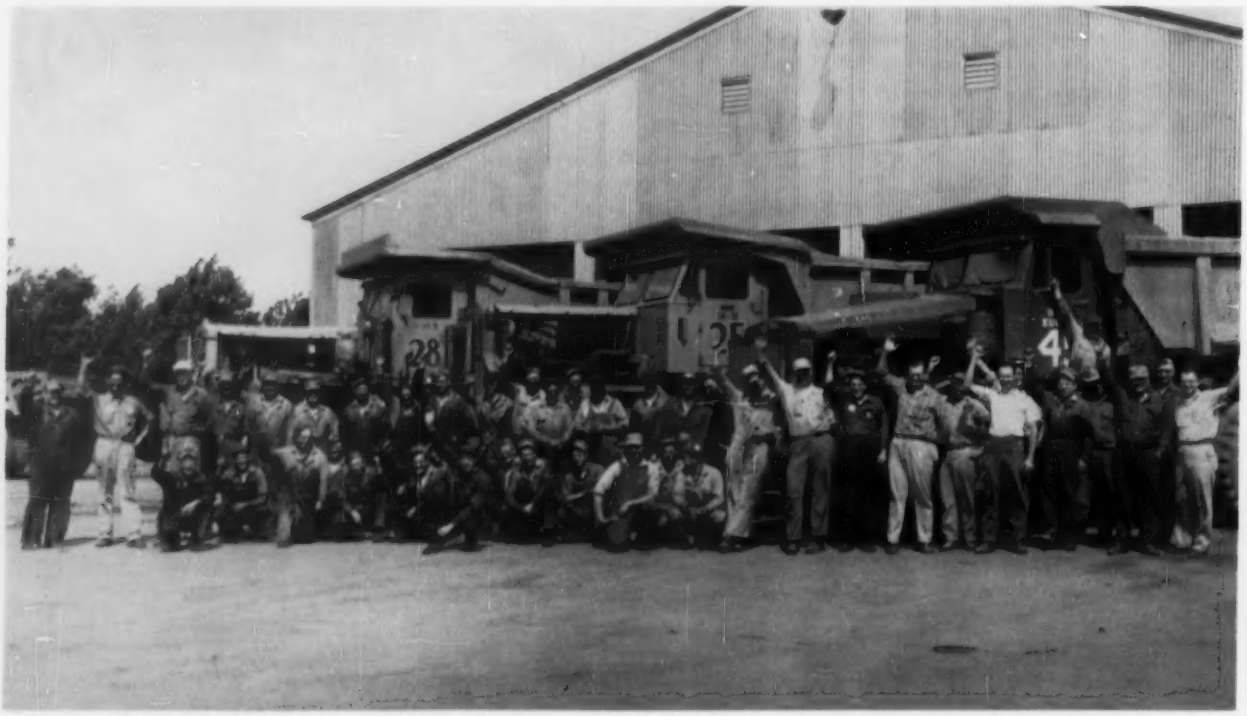
Summary of Results

A summary of some of the accomplishments in safety made in 1955 by the 529 mines and quarries located in 43 states reveals the following:

1. The injury-severity rate of 3.872 days lost per thousand man-hours was the lowest recorded in the 31-year history of the contest.

SUPERVISORY FORCE: Operations at Zenith Mine in 1955 were supervised by, left to right, seated, John Kotchevar, Carlo Buraglio, H. F. McFarland, B. S. Richards, C. J. Miron, Charles Matson. Standing, left to right, are John Chelesnik, John Labernik, Louis Benko, Mike Klobuchar, Urho Niemi, John Miklaucich, John Simonich, Joe Grahek, and Stanley Kent.

ABOVE GROUND AT ZENITH: The grounds, office building, and structures on the surface at Zenith Mine are typical of the care and attention to details at all Pickands Mather & Co. properties.



ERIE'S MECHANICAL EMPLOYES: Here are the men of the mechanical department at PM's Erie Commercial Mine. The Sentinels of Safety trophy was awarded to this open-pit mine for a perfect safety record during 1955 with a total worktime of 558,010 man-hours.

ERIE'S SAFETY COMMITTEE: Left to right, Matt Pirnat, Theodore Boese, Steven Galinatz, James Puller, Chester Wolczak, Charles Hill, Robert Johnson, Toivo Hakala, Assistant Superintendent R. W. Bell, and Safety Inspector Robert Scinto.

2. The injury-frequency rate of 19.424 per million man-hours of employe exposure was the lowest recorded since the competition was begun in 1925.

3. The number of disabling injuries, fatal and nonfatal, was a record low.

4. Forty per cent of the total enrolled plants operated a full year without a disabling injury.

5. Operations in the metal-mine group attained a new low-severity rate.

6. The frequency rate in the bituminous-coal group was the lowest on record.

7. A new low-frequency rate was established by the quarry group.

Application forms for enrollment in the National Safety Competition and copies of the contest rules may be obtained from the U. S. Department of the Interior, Bureau of Mines, Branch of Accident Analysis, Division of Safety, Washington 25, D. C.

AFTER A BLAST: Following a blast in the taconite formation in Erie Commercial Mine, a 6-cu. yd. electric shovel is put to work loading the broken material into a 34-ton truck.

ALL-TIME WINNERS

ANTHRACITE

1925—Hazle Brook Coal Company, *Upper Lehigh Mine*, Upper Lehigh, Pa.

1926—Jeddo-Highland Coal Company, *Highland No. 6 Mine*, Jeddo, Pa.

1927—Jeddo-Highland Coal Company, *Highland No. 6 Mine*, Jeddo, Pa.

1928—Jeddo-Highland Coal Company, *Highland No. 7 Mine*, Jeddo, Pa.

1929—Jeddo-Highland Coal Company, *Highland No. 6 Mine*, Jeddo, Pa.

1930—Coxe Brothers & Company, Inc., *Tomhicken Mine*, Jeddo, Pa.

1931—Jeddo-Highland Coal Company, *Highland No. 2 Mine*, Jeddo, Pa.

1932—Jeddo-Highland Coal Company, *Highland No. 7 Mine*, Jeddo, Pa.

1933—The Hudson Coal Company, *Stillwater Mine*, Vandling, Pa.

1934—Harleigh-Brookwood Coal Company, *Laurence Mine*, Mahanoy Plane, Pa.

1935—Jeddo-Highland Coal Company, *Jeddo No. 7 Mine*, Harleigh, Pa.

1936—Hazle Brook Coal Company, *Raven Run Mine*, Raven Run, Pa.

1937—Jeddo-Highland Coal Company, *Jeddo No. 7 Mine*, Harleigh, Pa.

1938—Colonial Colliery Company, *Greenough Mine*, Natalie, Pa.

1939—The Hudson Coal Company, *Eddy Creek Mine*, Olyphant, Pa.

1940—Hazle Brook Coal Company, *Midvalley Mine*, Wilburton, Pa.

1941—Eddie & Joe Coal Company, *Eddie & Joe Mine*, Simpson, Pa.

1942—Jeddo-Highland Coal Company, *Stockton Mine*, Stockton, Pa.

1943—Morgan Coal Mine, *Oregon Slope Mine*, Pittston, Pa.

1944—The Hudson Coal Company, *Miles Slope Mine*, Dickson City, Pa.

1945—Jermyn-Green Coal Company, *Butler Mine*, Pittston, Pa.

1946—Jermyn-Green Coal Company, *Butler Mine*, Pittston, Pa.

1947—Jermyn-Green Coal Company, *Butler Mine*, Pittston, Pa.

1948—Philadelphia and Reading Coal and Iron Company, *Hunter Tunnel Mine*, Ashland, Pa.

1949—Kehoe-Berge Coal Company, *Stevens Shaft Mine*, Exeter, Pa.

1950—The Hudson Coal Company, *Birdseye Mine*, Throop, Pa.

1951—Ploskonka Coal Company, *No. 5 Hill Mine*, Archbald, Pa.

1952—Philadelphia and Reading Coal and Iron Company, *Hunter Tunnel Mine*, Ashland, Pa.

1953—The Hudson Coal Company, *Coal Brook Mine*, Carbondale, Pa.

1954—Ploskonka Coal Company, *No. 5 Hill Mine*, Archbald, Pa.

1955—Raven Run Coal Company, *Germantown Colliery*, Centralia, Pa.

BITUMINOUS-COAL

1925—United States Coal and Coke Company, *No. 6 Mine*, Gary, W. Va.

1926—United States Coal and Coke Company, *No. 6 Mine*, Gary, W. Va.

1927—United States Coal and Coke Company, *No. 2 Mine*, Gary, W. Va.

1928—United States Coal and Coke Company, *No. 4 Mine*, Gary, W. Va.

1929—DeBardeleben Coal Corporation, *Hull No. 33 Mine*, Dora, Ala.

1930—Penn Central Light and Power Company, *No. 1 Mine*, Coalmont, Pa.

1931—Phelps-Dodge Corporation, *Dawson No. 1 Mine*, Dawson, N. Mex.

1932—Electro Metallurgical Company, Alloy, W. Va.

1933—The Union Pacific Coal Company, *"B" Mine*, Superior, Wyo.

1934—The Union Pacific Coal Company, *"C" Mine*, Superior, Wyo.

1935—Elkhorn Piney Coal Company, *Ingram Branch Mine*, Ingram Branch, W. Va.

1936—The Koppers Coal Company, *Coxton Mine*, Coxton, Ky.

1937—The Union Pacific Coal Company, *"D" Mine*, Superior, Wyo.

1938—The Union Pacific Coal Company, *"B" Mine*, Superior, Wyo.

1939—The Union Pacific Coal Company, *Winton No. 1 Mine*, Winton, Wyo.

1940—The Union Pacific Coal Company, *Rock Springs No. 4 Mine*, Rock Springs, Wyo.

1941—Electro Metallurgical Company, *Alloy No. 2 Mine*, Alloy, W.Va.

1942—Knife River Coal Company, *Knife River Mine*, Beulah, N. Dak.

1943—The Union Pacific Coal Company, *"D" Mine*, Superior, Wyo.

1944—The Union Pacific Coal Company, *"D" Mine*, Superior, Wyo.

1945—Rockhill Coal Company, *Rockhill No. 5 Mine*, Robertsdale, Pa.

1946—Consolidated Coal Company, *Bankhead No. 2 Mine*, Bankhead, Ala.

1947—The Union Pacific Coal Company, *Winton No. 1 and 7½ Mine*, Winton, Wyo.

1948—The Union Pacific Coal Company, *Reliance No. 7 Mine*, Reliance, Wyo.

1949—The Union Pacific Coal Company, *Reliance No. 7 Mine*, Reliance, Wyo.

1950—The Union Pacific Coal Company, *Reliance No. 7 Mine*, Reliance, Wyo.

1951—The Union Pacific Coal Company, *Reliance No. 7 Mine*, Reliance, Wyo.

1952—Tennessee Coal and Iron Division, United States Steel Corporation, *Short Creek Mine*, Adamsville, Ala.

1953—The Union Pacific Coal Company, *Hanna No. 4-A Mine*, Hanna, Wyo.

1954—Alabama By-Products Corporation, *Labuco Mine*, Flat Creek, Ala.

1955—Alabama By-Products Corporation, *Labuco Mine*, Flat Creek, Ala.

METAL

1925—New York Mining Company, *New York Mine (zinc and lead)*, Picher, Okla.

1926—Federal Mining and Smelting Company, *Muncie Mine (zinc and lead)*, Baxter Springs, Kans.

1927—The Bristol Mining Company, *Bristol Mine (iron)*, Crystal Falls, Mich.

1928—Brule Mining Company, *Berkshire Mine (iron)*, Stambaugh, Mich.

1929—Brule Mining Company, *Berkshire Mine (iron)*, Stambaugh, Mich.

1930—Penn Iron Mining Company, *West Vulcan Mine*, Vulcan, Mich.

1931—Hanna Ore Mining Company, *Harold Mine*, Carson Lake, Minn.

1932—St. Joseph Lead Company, *Balmat Mine (lead, zinc, and pyrites)*, Balmat, N. Y.

1933—Tennessee Copper Company, *Burra Burra Mine*, Ducktown, Tenn.

1934—Penn Iron Mining Company, *East Vulcan Mine*, Vulcan, Mich.

1935—Vermillion Mining Company, *Zenith Mine (iron)*, Ely, Minn.

1936—Penn Iron Mining Company, *East Vulcan Mine*, Vulcan, Mich.

1937—M. A. Hanna Company, *Hiawatha No. 1 Mine (iron)*, Iron River, Mich.

1938—Odanah Iron Company, *Cary Mine (iron)*, Hurley, Wis.

1939—M. A. Hanna Company, *Bates Mine (iron)*, Iron River, Mich.

1940—Phelps-Dodge Corporation, *Humboldt Mine*, Morenci, Ariz.

1941—American Zinc Company of Tennessee, *Grasselli Mine (zinc sulphide)*, New Market, Tenn.

1942—Tennessee Copper Company, *Boyd Mine*, Ducktown, Tenn.

1943—Penn Iron Mining Company, *East Vulcan Mine*, Vulcan, Mich.

1944—Youngstown Mines Corporation, *Newport Mine (iron)*, Ironwood, Mich.

1945—James Mining Company, *James Mine (iron)*, Iron River, Mich.

1946—Tennessee Copper Company, *Burra Burra Copper Mine*, Ducktown, Tenn.

1947—Oliver Iron Mining Company, *Soudan Mine*, Soudan, Minn.

1948—Oliver Iron Mining Company, *Fraser Mine*, Fraser, Minn.

1949—American Zinc Company of Tennessee, *No. 2 Mine*, Mascot, Tenn.

1950—Republic Steel Corporation, *Tobin Mine*, Crystal Falls, Mich.

1951—Oliver Iron Mining Company, *Soudan Mine*, Soudan, Minn.

1952—The Verona Mining Company, Pickands Mather & Company, *Buck Mine*, Caspian, Mich.

1953—Tennessee Copper Company, *Calloway-Mary Mine*, Ducktown, Tenn.

1954—Pickands Mather & Company, *Zenith Mine*, Ely, Minn.

1955—Pickands Mather & Company, *Zenith Mine*, Ely, Minn.

NONMETALLIC

1925—United States Gypsum Company, *Lower Gypsum Mine*, Gypsum, Ohio.

1926—The Beaver Products Company, Inc., *Grand Rapids Mine (gypsum)*, Grand Rapids, Mich.

1927—The Marquette Cement Manufacturing Company, *La Salle Mine (limestone)*, Oglesby, Ill.

1928—Alpha Portland Cement Company, *Ironton Mine (limestone)*, Ironton, Ohio.

1929—Retsof Mining Company, *Retsof Mine (rock salt)*, Retsof, N. Y.

1930—United States Gypsum Company, *Lower Gypsum Mine*, Gypsum, Ohio.

1931—Retsof Mining Company, *Retsof Mine (rock salt)*, Retsof, N. Y.

1932—Retsof Mining Company, *Retsof Mine (rock salt)*, Retsof, N. Y.

1933—Retsof Mining Company, *Retsof Mine (rock salt)*, Retsof, N. Y.

1934—The Marquette Cement Manufacturing Company, *La Salle Mine (limestone)*, Oglesby, Ill.

1935—Certain-teed Products Corporation, *Gypsum Mine*, Akron, N. Y.

1936—Tennessee Coal, Iron & Railroad Company, *No. 5 Mine (limestone)*, Bessemer, Ala.

1937—Tennessee Coal, Iron & Railroad Company, *No. 5 Mine (limestone)*, Bessemer, Ala.

1938—Avery Salt Company, Avery Island, La.

1939—Tennessee Coal, Iron & Railroad Company, *No. 5 Mine (limestone)*, Bessemer, Ala.

1940—Tennessee Coal, Iron & Railroad Company, *No. 5 Mine (limestone)*, Bessemer, Ala.

1941—The United States Gypsum Company, *No. 6 Mine (gypsum)*, Plasterco, Va.

1942—Alpha Portland Cement Company, *Ironton Mine (limestone)*, Ironton, Ohio.

1943—United States Gypsum Company, *No. 6 Mine (gypsum)*, Plasterco, Va.

1944—National Gypsum Company, *Akron Gypsum Mine*, Akron, N. Y.

1945—Freeport Brick Company, *Freeport Mine (clay)*, Freeport, Pa.

1946—Certain-teed Products Corporation, *Acme Gypsum Mine*, Acme, Texas.

1947—Tennessee Coal, Iron & Railroad Company, *No. 5 Mine (limestone)*, Bessemer, Ala.

1948—Alpha Portland Cement Company, *Ironton Mine*, Ironton, Ohio.

1949—National Gypsum Company, *Bellefonte Mine*, Bellefonte, Pa.

1950—Pittsburgh Plate Glass Company, *Barberton Limestone Mine*, Barberton, Ohio.

1951—International Salt Company, *Retsof Mine*, Retsof, N. Y.

1952—Michigan Limestone Division, United States Steel Corporation, *Annandale Mine (limestone)*, Boyers, Pa.

1953—Michigan Limestone Division, United States Steel Corporation, *Annandale Mine (limestone)*, Boyers, Pa.

1954—United States Gypsum Company, *No. 6 Mine (gypsum)*, Plasterco, Va.

1955—Warner Company, *Bell Mine*, Bellefonte, Pa.

OPEN-PIT AND QUARRIES

1925—North American Cement Corporation, *Security Quarry (limestone)*, Security, Md.

1926—North American Cement Corporation, *No. 5 and 6 Quarry (limestone)*, Martinsburg, W. Va.

1927—Lehigh Portland Cement Company, *Mitchell Quarry (limestone)*, Mitchell, Ind.

1928—Wakefield Iron Company, *Wakefield Open-pit Mine (iron)*, Wakefield, Mich.

1929—Michigan Limestone & Chemical Company, *Rogers City Quarry (limestone)*, Rogers City, Mich.

1930—Plymouth Mining Company, *Plymouth Open-pit (iron)*, Wakefield, Mich.

1931—Mahoning Ore & Steel Company, *Mahoning Open-pit Mine (iron)*, Hibbing, Minn.

1932—Michigan Limestone & Chemical Company, *Rogers City Quarry (limestone)*, Rogers City, Mich.

1933—Michigan Limestone & Chemical Company, *Rogers City Quarry (limestone)*, Rogers City, Mich.

1934—Michigan Limestone & Chemical Company, *Rogers City Quarry (limestone)*, Rogers City, Mich.

1935—Folsom State Prison, *Granite Quarry*, Folsom, Calif.

1936—Hanna Ore Mining Company, *Mesabi Chief Mine (iron)*, Keewatin, Minn.

1937—Illinois State Penitentiary, *Limestone Quarry*, Menard, Ill. (Separated into Individual Groups in 1938.)

OPEN-PIT

1938—Pickands Mather & Company, *Mahoning Mine (iron-ore)*, Hibbing, Minn.

1939—Pickands Mather & Company, *Scranton Mine (iron-ore)*, Hibbing, Minn.

1940—Pickands Mather & Company, *Mahoning Mine (iron-ore)*, Hibbing, Minn.

1941—Pickands Mather & Company, *Mahoning Mine (iron-ore)*, Hibbing, Minn.

1942—Pickands Mather & Company, *Mahoning Mine*, Hibbing, Minn.

1943—Pickands Mather & Company, *Danube Mine*, Bovey, Minn.

1944—Pickands Mather & Company, *Danube Mine*, Bovey, Minn.

1945—Pickands Mather & Company, *Mahoning Mine*, Hibbing, Minn.

1946—Oliver Iron Mining Company, *Rouchleau Iron-ore Pit*, Virginia, Minn.

1947—Pickands Mather & Company, *Mahoning Mine*, Hibbing, Minn.

1948—Oliver Iron Mining Company, *Spruce Open-cut Mine*, Eveleth, Minn.

1949—Pickands Mather & Company, *Embarrass Mine*, Biwabik, Minn.

1950—Pickands Mather & Company, *Embarrass Mine*, Biwabik, Minn.

1951—Oliver Iron Mining Company, *Mt. Iron Mine*, Mt. Iron, Minn.

1952—International Minerals and Chemical Corporation, *Noralyn Mine*, Bartow, Fla.

1953—Pickands Mather & Company, *Mahoning Mine*, Hibbing, Minn.

1954—Pickands Mather & Company, *Mahoning Mine*, Hibbing, Minn.

1955—Pickands Mather & Company, *Eric Commercial Mine*, Aurora, Minn.

QUARRIES

1938—Inland Lime & Stone Company, *Port Inland Quarry (limestone)*, Manistique, Mich.

1939—Inland Lime & Stone Company, *Port Inland Quarry (limestone)*, Manistique, Mich.

1940—Tennessee Coal, Iron & Railroad Company, *Dolonah Quarry (dolomite)*, Bessemer, Ala.

1941—Tennessee Coal, Iron & Railroad Company, *Dolonah Quarry (dolomite)*, Bessemer, Ala.

1942—Bethlehem Steel Company, *Hanover Quarry*, Hanover, Pa.

1943—Wyandotte Chemicals Corporation, *Alpena Quarry*, Alpena, Mich.

1944—Basic Refractories, Inc., *Maple Grove Quarry (dolomite)*, Maple Grove, Ohio.

1945—Bethlehem Steel Company, *Bridgeport Quarry (limestone)*, Bridgeport, Pa.

1946—Bethlehem Steel Company, *Bridgeport Quarry (limestone)*, Bridgeport, Pa.

1947—Tennessee Coal, Iron & Railroad Company, *Dolonah Quarry (dolomite)*, Bessemer, Ala.

1948—Bethlehem Steel Company, *Hanover Quarry*, Hanover, Pa.

1949—Tennessee Coal, Iron & Railroad Company, *Dolonah Quarry (dolomite)*, Bessemer, Ala.

1950—Michigan Limestone & Chemical Company, *Rogers City Quarry (limestone)*, Rogers City, Mich.

1951—Inland Lime & Stone Company, *Port Inland Quarry (limestone)*, Gulliver, Mich.

1952—Michigan Limestone Division, United States Steel Corporation, *Hillsville Quarry (limestone)*, Hillsville, Pa.

1953—Wyandotte Chemicals Corporation, *Alpena Quarry*, Alpena, Mich.

1954—Material Service Corporation, *Thornton Quarry (limestone)*, Thornton, Ill.

1955—United States Steel Corporation, *Hillsville Limestone Quarry*, Hillsville, Pa.

Awards of Certificates of Achievement in Safety

RULES of the competition provide for the award of Certificates of Achievement in Safety to each mine or quarry, other than the trophy winners, whose position in the contest was among the first four in its respective group. These mines and quarries are listed below.

Certificates are also awarded each injury-free mine or quarry that worked 30,000 or more man-hours during the 12 consecutive months of each contest. In the 1955 competition, there were 176 plants that received certificates. We regret that space limitations do not permit listing all of the recipients.

ANTHRACITE MINES

St. Clair mine, St. Clair, Schuylkill County, Pa., operated by The St. Clair Coal Co., worked 211,642 man-hours with 8 disabling injuries that caused 349 days of disability. The injury-severity rate was 1.649.

Goodspring mine, Goodspring, Schuylkill County, Pa., operated by the Penag Coal Co., worked 101,591 man-hours with 6 disabling injuries that caused 201 days of disability. The injury-severity rate was 1.979.

Dorrance Shaft mine, Wilkes-Barre, Luzerne County, Pa., operated by the Lehigh Valley Coal Co., worked 508,776 man-hours with 31 disabling injuries that caused 1,174 days of disability. The injury-severity rate was 2.307.

Loree 2, 4, and 5 mine, Plymouth, Luzerne County, Pa., operated by The Hudson Coal Co., worked 833,312 man-hours with 65 disabling injuries that caused 2,316 days of disability. The injury-severity rate was 2.779.

BITUMINOUS-COAL MINES

Rock Springs No. 8 mine, Rock Springs, Sweetwater County, Wyo., operated by The Union Pacific Coal Co., worked 74,894 man-hours without a disabling injury.

Patton Clay Mine No. 1, Patton, Cambria County, Pa., operated by the Patton Clay Manufacturing Co., worked 38,966 man-hours with 1 disabling injury that caused 4 days of disability. The injury-severity rate was 0.103.

Sayreton mine, Sayreton, Jefferson County, Ala., operated by the Republic Steel Corporation, worked 444,739 man-hours with 1 disabling injury that caused 62 days of disability. The injury-severity rate was 0.139.

Karen mine, Fredericktown, Washington County, Pa., operated by the United States Steel Corp., worked 477,656 man-hours with 1 disabling injury that caused 88 days of disability. The injury-severity rate was 0.184.

METAL MINES

Wenonah No. 8 red iron-ore mine, Bessemer, Jefferson County, Ala., operated by the Tennessee Coal and Iron Div., United States Steel Corp., worked 421,850 man-hours without a disabling injury.

Zinc mines, Jefferson City, Jefferson County, Tenn., operated by the Tennessee Coal and Iron Div., United States Steel Corp., worked 362,112 man-hours without a disabling injury.

Armour No. 1 iron-ore mine, Ironton, Crow Wing County, Minn., operated by the Inland Steel Co., worked 231,072 man-hours without a disabling injury.

Eureka copper, zinc and iron sulphide mine, Ducktown, Polk County, Tenn., operated by the Tennessee Copper Co., worked 225,942 man-hours without a disabling injury.

NONMETALLIC MINES

No. 3 limestone mine, Valmeyer, Monroe County, Ill., operated by Columbia Quarry Co., worked 227,587 man-hours without a disabling injury.

Jonathan limestone mine, East Fultonham, Muskingum County, Ohio, operated by Pittsburgh Plate Glass Co., Columbia Cement Div., worked 155,653 man-hours without a disabling injury.

Kimballton chemical pebble lime mine, Kimballton, Giles County, Va., operated by The Standard Lime and Cement Co., worked 120,142 man-hours without a disabling injury.

Clarence Center gypsum rock mine, Clarence Center, Erie County, N. Y., operated by Universal Atlas Cement Co., worked 91,168 man-hours without a disabling injury.

OPEN-PIT MINES

Mahoning iron-ore mine, Hibbing, St. Louis County, Minn., operated by Pickands Mather and Co. (Mahoning Ore and Steel Co.), worked 420,832 man-hours without a disabling injury.

Embarrass iron-ore mine, Biwabik, St. Louis County, Minn., operated by Pickands Mather and Co. (Lake Mining Co.), worked 405,384 man-hours without a disabling injury.

Portsmouth iron-ore mine, Crosby, Crow Wing County, Minn., operated by The M. A. Hanna Co. (Hanna Iron Ore Co.), worked 331,504 man-hours without a disabling injury.

Iron Mountain iron-ore mine, Provo, Iron County, Utah, operated by Columbia Iron Mining Co., worked 271,250 man-hours without a disabling injury.

QUARRIES

Bessemer limestone quarry, Bessemer, Lawrence County, Pa., operated by Bessemer Limestone and Cement Co., worked 229,230 man-hours without a disabling injury.

Glen Mills trap-rock quarry, Glen Mills, Delaware County, Pa., operated by The General Crushed Stone Co., worked 222,987 man-hours without a disabling injury.

Dolonah dolomite quarry, Bessemer, Jefferson County, Ala., operated by Tennessee Coal and Iron Div., United States Steel Corp., worked 212,190 man-hours without a disabling injury.

Moler dolomite quarry, Millville, Jefferson County, W. Va., operated by Michigan Limestone Div., United States Steel Corp., worked 202,835 man-hours without a disabling injury.

A FOUR-LANE HIGHWAY-CONSTRUCTION JOB IN TEXAS

Contractors' trucks traveled 20,078,915 ton-miles in delivering crushed limestone for a 10.6-mile section of new highway east of Dallas

LEWIS NORDYKE*

THE vast terrain of Texas is criss-crossed by more than 200,000 miles of roadways, about 50,000 miles of which were paved and are maintained under the direction and supervision of the Texas Highway Department. This is equivalent to a four-lane speedway around the world at the big middle.

The construction of these highways in Texas during the past 50 years involved some prodigious projects. In many cases, rights-of-way were blasted through mountains and hills; bridges were built over rivers and streams; a tremendous tonnage of crushed stone and surfacing materials was supplied; and glistening pavements were laid for lengths so long that they taper out of sight over the prairie lea.

One of the biggest of these many highway projects, everything considered, was the construction of a 10.6-mile section of limited-access, express-type, four-lane structure on historic U. S. Route 80 just east of Dallas. Its

*2809 Lipscomb Street
Dallas, Texas

THE BIG PIT: This view of one end of the big pit shows the quarry working face of limestone 25 ft. high, some of the operating equipment, and portable crushing plants of two of the contractors near the rim of the pit.

EASY DIGGING: Results from primary blasts in the quarry provided economical digging and loading operations for the shovels and rapid deliveries of broken rock to the crushing plants.

total cost, running to $3,400,000, is among the top-level records for this type of construction.

Included in this total cost figure of $3,400,000 is $1,814,140, the cost of surfacing and finishing the highway. The contract for this latter phase of the project was awarded to Ernest Loyd, a veteran contractor of Fort Worth. The details involved in supplying material for surfacing the new express-type highway is what made the job such a whopper.

Crushed Stone Requirements

Crushed stone for the 21-in.-thick base was obtained from a below-surface quarry in the Ables Spring community in Kaufman County, 14 miles northeast of Terrell, and 30 to 37 miles from the construction job site. The quarry location is on the edge of a blackland prairie in an area of sandy loam hillocks, with an occasional outcrop of limestone and gravel. Parts of the quarry had been worked for years but no major use of the stone produced had been made.

The new highway called for approximately 637,000 tons of crushed and sized limestone for its base and surfacing. The longest haul from the quarry to the construction site was 37 miles, with the average just under 30. In supplying this material to the job, the haulage of the crushed limestone soared to 20,078,915 ton-miles, topping by far any previous job of this kind in Texas.

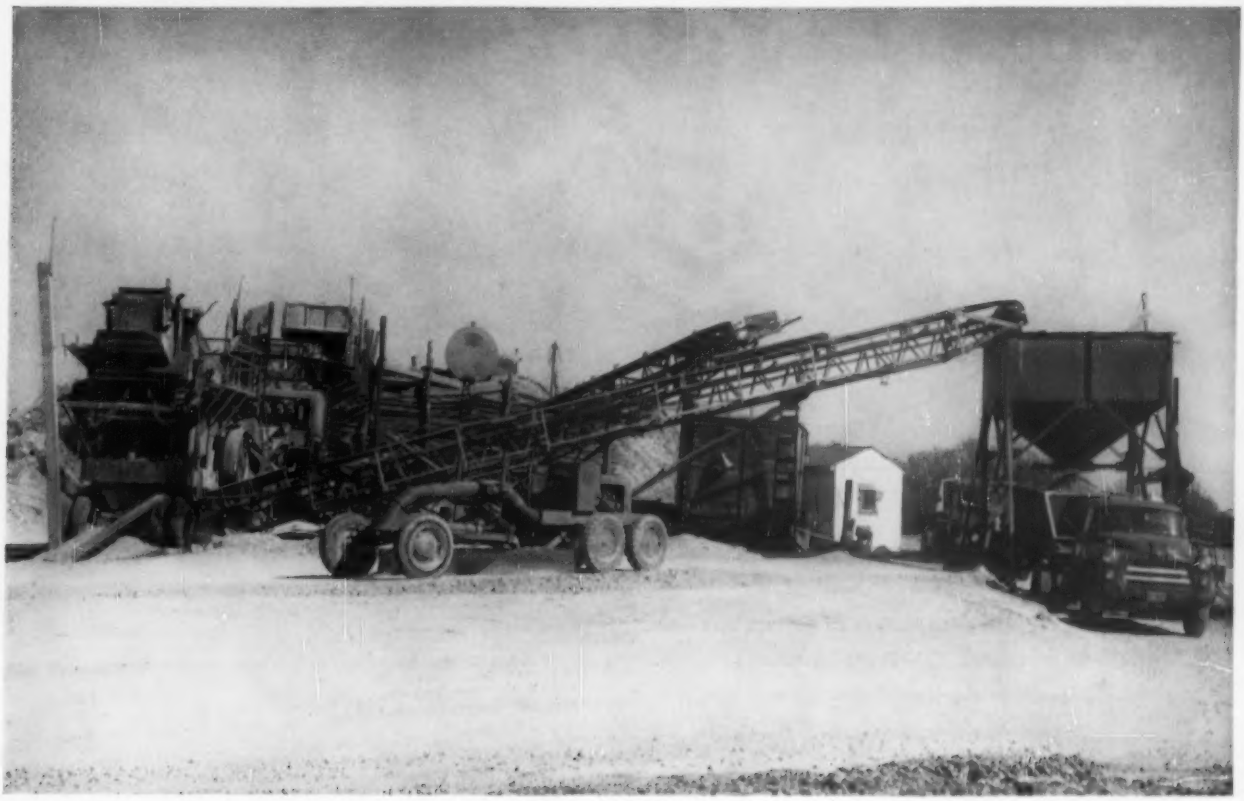
The amount of variable equipment needed to produce such a big tonnage of crushed stone and to make hundreds of truck deliveries 30 to 37 miles distant resulted in Mr. Loyd's subletting some of his contract to three contractors: Dew Construction Company of Tyler took on a 3-mile section; Boswell & Hanson Construction Company of Pampa was allotted 2.5 miles; Harry Campbell of Fort Worth, 2 miles; and Mr. Loyd retained the remaining 3.1 miles. Each subcontractor agreed to do his own quarrying, crushing, hauling, and surfacing. Mr. Loyd was responsible to the Highway Department for completion of the work.

Stripping Overburden

After the contractors moved onto the job site with their crews and equipment, the first order of business was stripping 23 ft. of loamy overburden from the top of the quarry face to uncover a stratum of limestone 25 ft. thick. This stripping resulted in the removal of 423,000 cu. yd. of earth and conglomerate. The floor of the quarry was approximately 50 ft. below the surface level. From the top of the quarry, the operation looked a good deal like an open-pit mine.

Because of divided ownership of the

AT THE JOB SITE: After the 30-mile trip to the project, the crushed stone from the quarry was dumped in solid windrowlike terraces in the center of the right-of-way. The four sections of the new highway were under construction at the same time.



CRUSHING PLANT: A closeup of the portable crushing plant of Dew Construction Company with a truck being loaded with crushed and sized limestone for delivery to the new highway job. Equipment included a 30 by 42 Pioneer jaw crusher and a 22 by 54 roll.

quarry property, a slight variation in the limestone formation, and the different locations of the four contractors' rock-crushing units, the layout was separated into two pits, one large and one small. A tall terrace of waste material separated the two pits. There was very little difference in the blasting methods in the two sections of the quarry.

In the big pit, where the portable crushing plants of Loyd, Boswell & Hanson, and Campbell were located on the rim of the quarry face, the details of drilling and blasting were conducted on a bench averaging 23 ft. high. The blast holes were drilled 3⅞ in. in diameter and 23½ ft. deep, using a Mayhew rotary drill (a seismograph-type rig) mounted on a Ford truck. Air for the drill was supplied by a Gardner-Denver 315 compressor. The holes were started with a Varel V2 bit and finished with a Hawthorne of the same size. The bit change was made because the rock formation was slightly softer at the bottom of the holes.

Blasting in the Big Pit

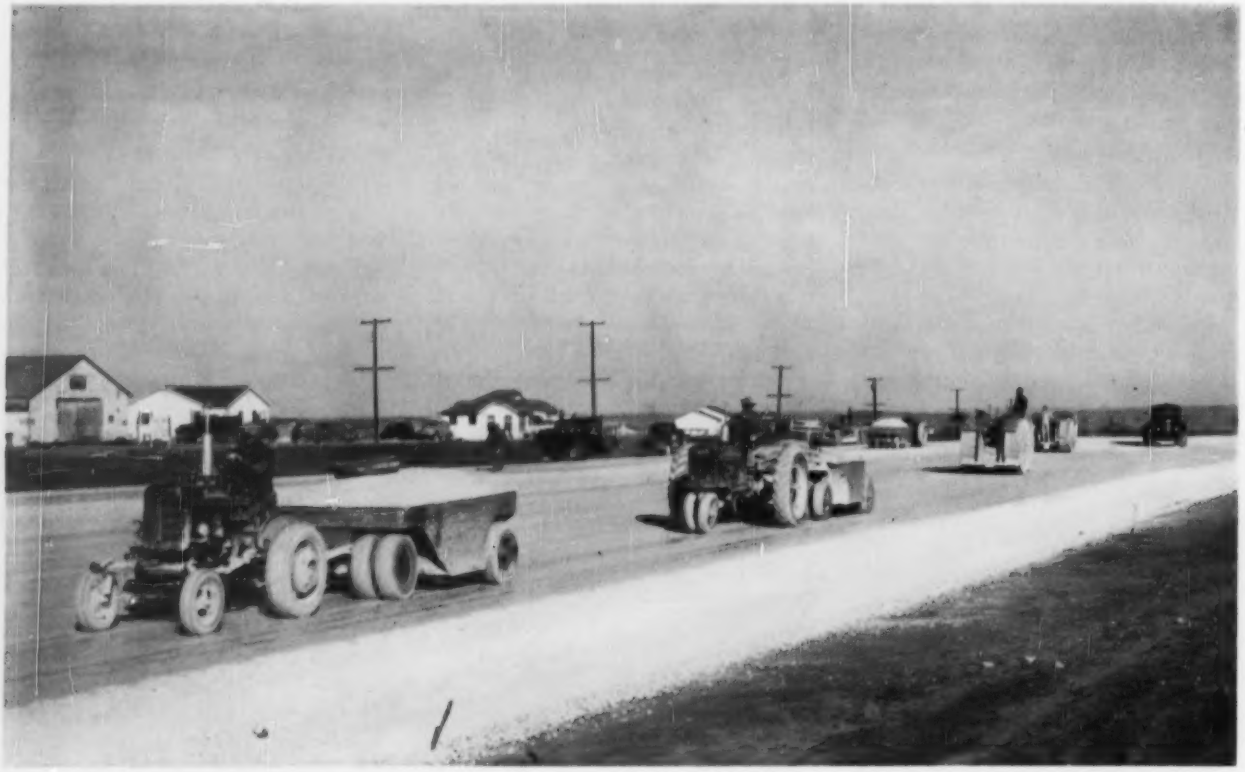
A typical primary blast in the big pit comprised four rows of holes, 25 holes to a row, drilled on a staggered pattern. Hole spacings were on 11-ft. centers with 6 ft. of burden on each hole. A combination charge of Gelamite® 2 and Hercomite® 2 was deck-loaded into each hole on a ratio of 0.9 lb. of dynamite to each cu. yd. of rock in the solid. The dynamite cartridge sizes were 3 by 24 in., 3 by 16 in., and 2 by 8 in. Both the bottom and the top charge in each hole were primed with a short-period delay electric blasting cap. The periods of delay caps throughout a blast were 1 to 12 inclusive. Drill cuttings were used to stem the explosives to the collar of each hole. Blasts were fired with a Hercules Titan blaster.

This method of drilling and loading, and the use of short-period delay electric blasting caps, produced a progressive blast, similar to a sloughing action. Fragmentation of the limestone was consistently satisfactory. Uniformly good rock breakage from primary blasts was important because the contractors' crushing units were limited as to the size of rock they could handle. Very little secondary blasting was required of the contractors.

Blasting in Small Pit

The height of the bench in the small pit was 18 ft. Holes for blasting were drilled to the bottom of the bench, starting with a 2⅞-in. diameter and ending with a 2⅝-in. diameter, using Timken rock bits. The drilling equipment consisted of two Gardner-Denver wagon drills, with air supplied by two Gardner-Denver compressors — a 315 and a 365. The bottom 5 ft. of each hole was loaded with Gelamite 2 in 2 by 8-in. cartridges primed with a short-period delay electric blasting cap. Then 2 to 3 ft. of drill cuttings were tamped in, after which the hole was loaded with the same grade and size of dynamite to within 24 in. of the hole collar. The top dynamite charge was also primed with a short-period delay electric blasting cap. An aver-

SPREADING THE STONE: The stone was spread and leveled off over the new right-of-way with No. 12 Caterpillar maintainers.



COMPRESSING THE BASE: The spread stone is then wet with a sprinkler truck and compressed with a variety of rollers.

NEW, WIDE HIGHWAY: The base for each strip (two lanes) is 38 ft. wide, to be paved with asphaltic concrete. The shoulders on each strip are hard-surfaced material 14 ft. wide. Construction work was done without a detour and without hampering traffic.

age primary blast included 70 holes in four rows. The holes were spaced on 9-ft. centers with a 4-ft. burden on each hole. The charges were connected with a four-series hook-up and fired with a Hercules 50-cap blasting machine. The results were uniformly satisfactory.

All blasts were fired at the end of a one-shift day, shortly after 5 p.m. In excavating the blasted rock, several springs in the quarry were opened and a good deal of water had to be pumped out. However, the water was not a serious problem, other than creating a few bogs. No. 5 and No. 7 Caterpillar dozers handled the blade work, pushing aside the few boulders and keeping clear the roadways and the areas around the power shovels.

After blasting, the broken rock was loaded out with Lorain 80 and Northwest Model 6 revolving shovels, with 2-cu. yd. and 1¾-cu. yd. dippers, respectively. An Allis-Chalmers No. 9 Endloader helped out when shovel production lagged a bit in the small end of the quarry. The blasted rock was dumped into 8- and 10-cu. yd. Euclids, 6-cu. yd. Koehring Dumpsters, and 3-ton International trucks. The roadways to and from the pits and the crushers were only a fraction of a mile long, but the grades were fairly steep. Maintenance of these roadways was accomplished with material from the crushers of the four contractors.

Crushing and Hauling The Limestone

The Loyd crushing plant included a 30 by 42 Pioneer jaw crusher for primary rock reduction to 9 in., a 24 by 36 Pioneer jaw which reduced to 6 in., and a 22 by 40 Pioneer roll for reduction to 2 in. The plant, powered by Caterpillar engines, had a capacity of 200 cu. yd. an hour. The Campbell and Dew plants were alike, each with a 30 by 42 Pioneer jaw crusher and a 22 by 54 Pioneer roll, powered by D-17000 Caterpillar motors. The Bos-

DISCUSSING JOB PROGRESS: The prime contractor, Ernest Loyd, discusses job progress with Superintendent Dueal Ellis, at right, and Bert Slade, blasting foreman, at left.

well & Hanson setup had a 25 by 40 jaw crusher, followed by a 20 by 36 and a 22 by 40 secondary units, all of Cedar Rapids manufacture.

The hauling of the crushed stone to the highway construction site was an enormous task involving more than 150 trucks. The haulage contractors were H. Petree & Sons of Dallas with thirty trucks, 10- to 15-cu. yd. cable dump; the D. and S. Trucking Company of Tyler with forty 10-cu. yd. Omaha Standards and ten 10-cu. yd. Fruehaufs, all with center dumps; and Roberts Brothers, Inc., of Corpus Christi with seventy-two 10-cu. yd. custom-built side dumps.

The fleets of trucks kept the road hot between the crushers and the construction site. The longest distance of the 29-mile-plus average haul was over busy U. S. 80 and through the towns of Terrell and Forney. The crushed stone was dumped in solid windrow-like terraces in the center of the job right-of-way. The four sections – that of the prime contractor and the three subcontractors – were under construction at the same time.

The flexible base of the roadway was laid in 5½-in. layers. After the material was dumped, it was spread with No. 12 Caterpillar maintainers and compacted with rollers, ranging from 10-ton Ingrams down to small pneumatic rollers pulled by Farmall tractors. Besides the Ingrams, the compacting equipment included Grace pneumatic rollers and sheepfoot rollers. The slush system of heavy sprinkling with water and rolling while wet was used. After the 21 in. of compacted crushed limestone were applied, the base was primed with asphalt and topped with 2¼ in. of asphaltic concrete, known as hot mix, supplied by the Texas Bitulithic Company of Dallas. The Highway Department required a perfectly smooth surface.

Completed Highway

This stretch of new highway, known officially as Project No. FI 526 (12), District 18, Dallas-Kaufman County, U. S. 80, is quite a road. The base for each strip (two lanes) is 38 ft. wide and the asphaltic concrete paving on each strip is 24 ft. wide, making a total of 48 ft. of paving in the divided four-lane thoroughfare. There are 14 ft. of hard-surfaced shoulders on each strip. In addition to the main highway, there are service roads alongside it and crossing it through underpasses. These service roads are mainly for residents of the area along the highway. There are no crossings over this section of U. S. 80.

Although the new four-lane roadway is along the widened right-of-way of the old highway, the construction work was done without a detour and without hampering traffic. In some areas the old pavement will be used in the service road network.

First work on the make-ready for this big job of blasting, crushing, hauling, and highway construction was done in September, 1954, after the engineering plans had been worked out and additional right-of-way obtained. This initial work, accomplished on separate contracts from the actual road construction, included the grading and drainage structures, the bridges, and the underpasses.

Texas Highway Department

All engineering and inspection details were handled by the Highway Department. This department, established in 1917, is administered by a Highway Commission of three members appointed by the governor. Headquarters are in Austin, the state capital. All work on the new highway project on U. S. 80 was under the supervision of Frank W. Cawthon, district engineer for the department; T. A. Smith, resident engineer; and M. W. Shepherd, chief inspector.

The Texas Highway Department is a good partner but a strict one. One story that's told about a contractor with more than his share of inspection troubles goes something like this: The department's inspector found the base too thin, the shoulders too sloping, the finish too rough; in fact, everything was wrong. After listening to all the complaints, the contractor asked: "Well, Mr. Inspector, how is she for length?"

As in the case of the Dallas-Kaufman County U. S. 80 project, which is a realistic sign of big things to come, explosives have played an important part in the construction of Texas highways. In remaking older thoroughfares – widening, straightening, and reducing grades – a great deal of blasting is required. Rather than work around a hill, or go over it, today's contractor blasts his way through it. The grade on many of the state's main highways in the more rugged terrain has been reduced by blasting away the hills.

In this dawning day of superhighways, paced by the Government's $33-billion road-building program over the next 13 years, the big construction job on old-new U. S. 80 east of Dallas will be dwarfed by some of the contracts to be let before many months roll around.

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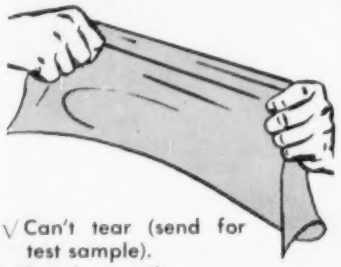

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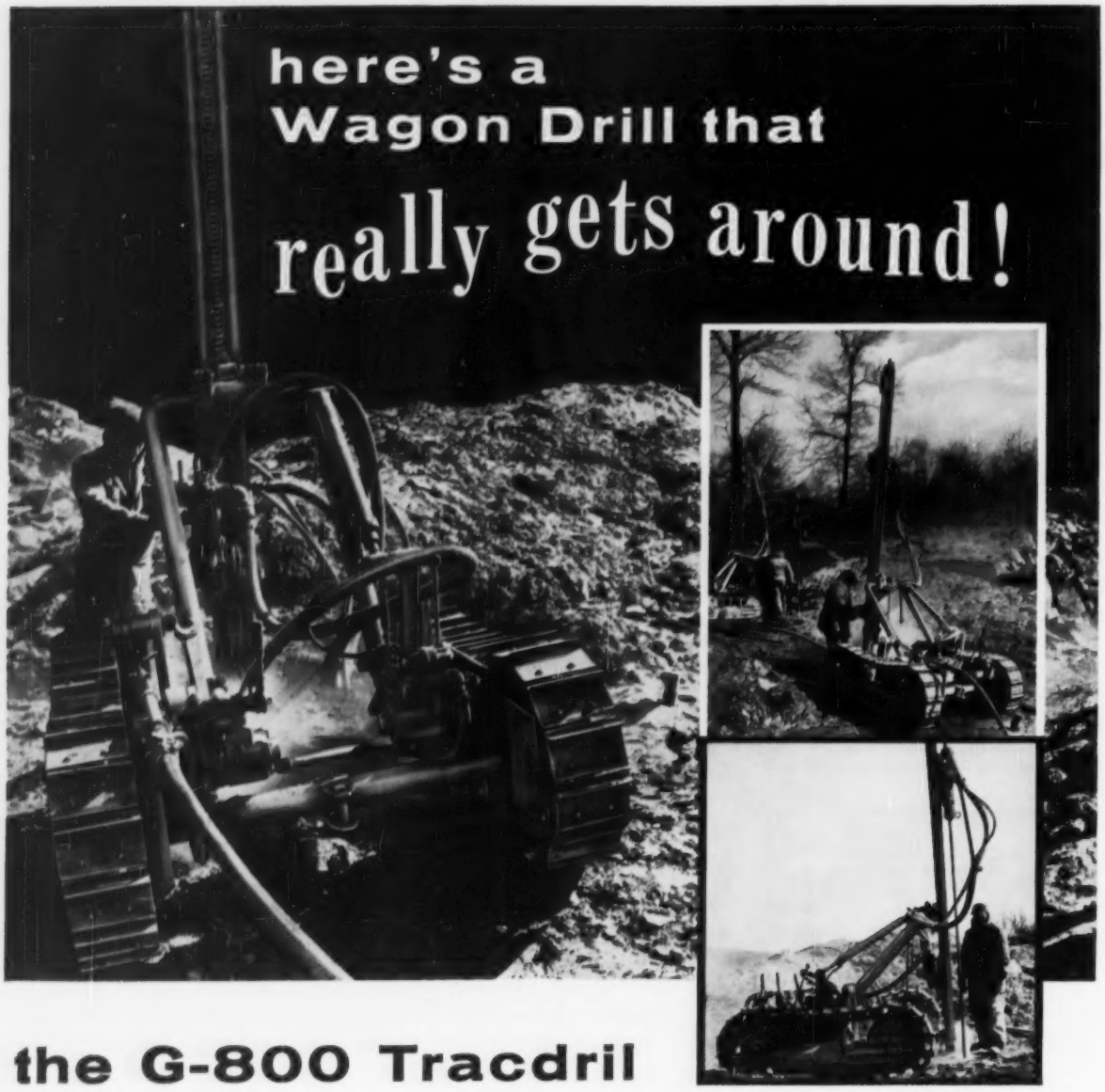

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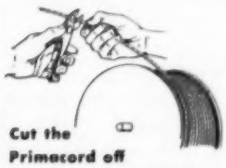

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